National Aeronautics and Space Administration

SpaceNet 2: Modeling the Logistical Impact of the "ilities" on Future Interplanetary Exploration Campaigns

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Project Objective:

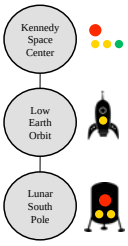
Model space exploration from a logistics perspective

Evaluate exploration missions with respect to feasibility and performance

Quantify the impact of reconfigurability, reusability, commonality, and repairability on exploration campaigns

Demonstrate the "ilities" in the context of relevant use cases

Support trade studies and identify strategies that maximize exploration value



FY09 Results:

Model the architectural impacts of the "ilities" over extended sets of missions (campaigns)

- Reconfigurability (change operational states)
- Reusability (element reuse across missions)
- Commonality (spare parts scavenging and pooling)
- Repairability (trade spares mass for agent time)

Re-design the software framework

- Object-oriented model (Java)
- Modular architecture extensible to future upgrades
- Platform independent, no licenses required

Deliverables

- SpaceNet 2.5 executable
- User's manual
- ISS/Lunar/Mars scenarios

Benefits to NASA and JPL:

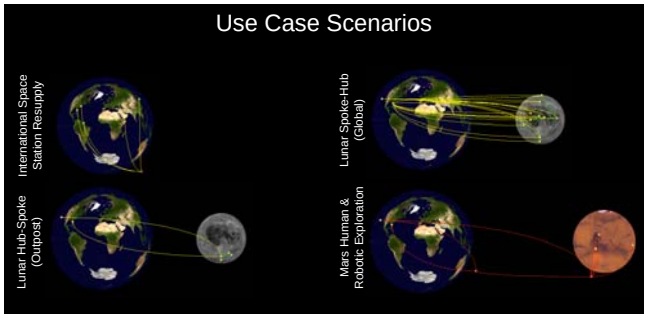
SpaceNet provides a computational environment to analyze and evaluate any user-generated scenario

- ISS Resupply (post-shuttle retirement)
- Lunar Missions (sortie / outpost / global exploration)
- Mars Campaign (DRA 5.0)

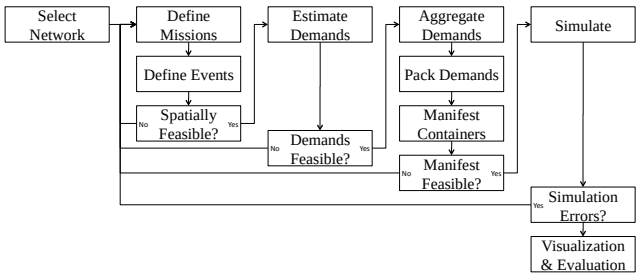
Explore the space logistics tradespace

- What mix of supply chain strategies best supports exploration?
- What is the optimal ratio of science mass, spare parts, and supplies?
- How do uncertainties impact logistics and exploration?
- What effect do delayed or cancelled missions have?
- What are the downstream impacts of technology improvements?

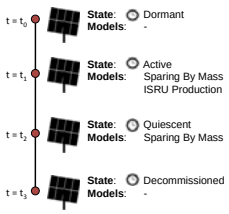
Use Case Scenarios



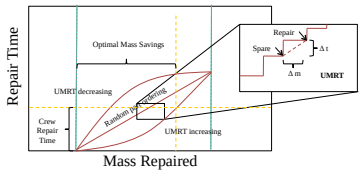
Scenario Creation



Reconfigurable States



Repairability Tradeoff



*UMRT = Unit Mass Repair Time (1 kg)

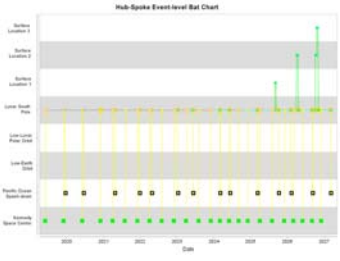


Figure 1. Sequence of Lunar Outpost Missions

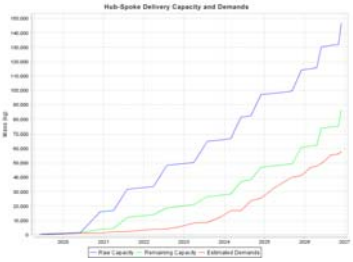


Figure 2. Delivery Capability vs. Cargo Demands, Cumulative

Publications:

Grogan P., Armar N., Siddiqi A., de Weck O., Shishko R., Lee G., Jordan E., "A Flexible Architecture and Object-Oriented Model for Space Logistics Simulation", AIAA-2009-6548, *AIAA Space 2009 Conference and Exposition*, Pasadena, California, September 14-17, 2009.

(Selected Past Publications)

Lee G., de Weck O., Armar N., Jordan E., Shishko R., Siddiqi A., Whiting J., "SpaceNet: Modeling and Simulating Space Logistics", AIAA-2008-7747, *AIAA Space 2008 Conference and Exposition*, San Diego, California, September 9-11, 2008.

de Weck O., Simchi-Levi D., Shishko R., Ahn J., Gralla E., Klabjan D., Mellein J., Shull A., Siddiqi A., Bairstow B, Lee G., "SpaceNet v1.3 User's Guide", NASA/TP-2007-214725, January 2007.

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